

Development of an Exploration-Class Cascade Distillation Subsystem: Performance Testing of the Generation 1.0 Prototype

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The ability to recover and purify water is crucial for realizing long-term human space missions. The National Aeronautics and Space Administration and Honeywell co-developed a five-stage vacuum rotary distillation water recovery system referred to as the Cascade Distillation Subsystem (CDS). Over the past three years, NASA's Advanced Exploration Systems (AES) Water Recovery Project (WRP) has been working toward the development of a flight-forward CDS design. In 2012 the original CDS prototype underwent a series of incremental upgrades and tests intended to both demonstrate the feasibility of an on-orbit demonstration of the system and to collect operational and performance data to be used to inform a second generation design. The latest testing of the CDS Generation 1.0 prototype was conducted May 29 through July 2, 2014. Initial system performance was benchmarked by processing deionized water and sodium chloride. Following, the system was challenged with analogue urine waste stream solutions stabilized with an Oxone-based and the two International Space Station baseline and alternative pretreatment solutions. During testing, the system processed more than 160 kg of wastewater with targeted water recoveries between 75 and 85% depending on the specific waste stream tested. For all wastewater streams, contaminant removals from wastewater feed to product water distillate, were estimated at greater than 99%. The average specific energy of the system was less than 120 W-hr/kg. The following paper provides detailed information and data on the performance of the CDS as challenged per the WRP test objectives.

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